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ROCKS and MINERALS

A Magazine for Mineralogist, Geologist and Collector . . . .

. . . . . Official Journal of
The Rocks and Minerals Association

..APRIL, 1937..

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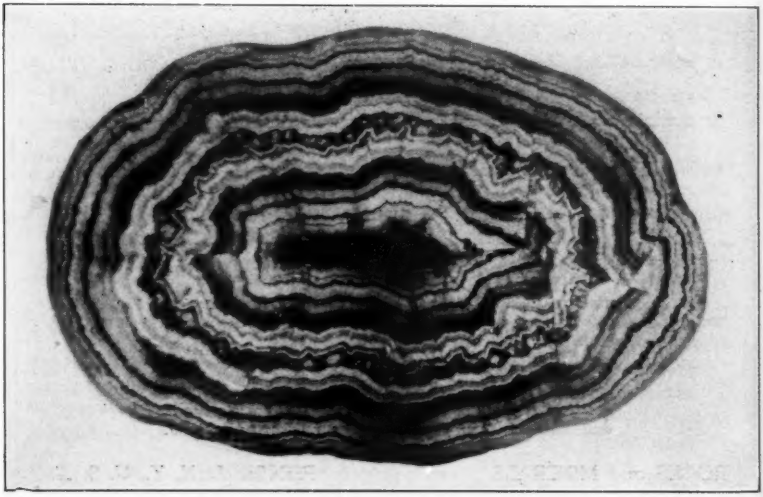
FLUORITE CRYSTAL FROM ILLINOIS



FLUORITE (Blue John) POLISHED SLAB FROM CASTLETON
DERBYSHIRE, ENGLAND

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The Official Journal ROCKS and MINERALS of the ASSOCIATION

WHOLE No. 69

YE ANCIENT COPPER MINE OF ARENT SCHUYLER

Within Plain View of the White Towered Skyline of Manhattan Lies the Eerie Entrance to the Oldest Copper Mine in the United States. Herewith is Sketched Some Account of Its Long and Romantic History, of the First Steam Engine in America Set Up to Pump Its Waters in 1755, and of Recent Explorations in Its Cavernous Labyrinth.

By O. IVAN LEE, Jersey City, N. J.

Few people realize that Colorado alone exceeds New Jersey, in the value and diversity of its mineral wealth, and fewer still are aware that several hundred iron and copper mines have been operated within easy commuting distance of New York. Even mining engineers are not infrequently surprised to learn that an extensive copper mine whose history can be traced back to the days of the Dutch lies under the town of North Arlington on the edge of the red sandstone hill which skirts the western margin of the Hackensack meadows.

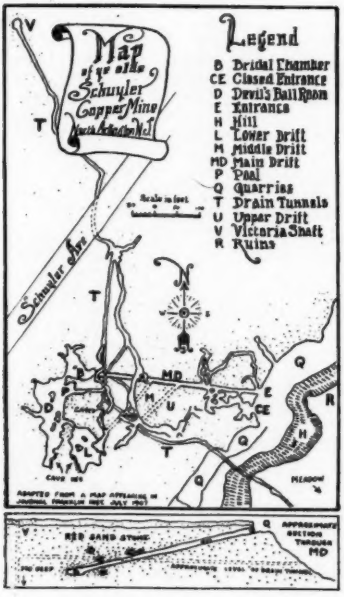
The Schuyler Mine, as it is usually called, lies in Bergen County upon property secured by Captain William Sanford of the British Army from one William Kingsland after whom the town of Kingsland, located on the same estate, is named. Captain Sanford's patent was issued July 4, 1668, payment being stipulated as "twenty pounds Sterling per annum, forever," in addition to gifts to the natives of several hundred strings of wampum, knives, brandy, etc., and conveyed some 30,000 acres lying between the Hackensack and Passaic rivers, one-third being meadowland. Shortly after this sale, however, Sanford transferred the northern portion of this tract to Kingsland again and from him, in 1710, Arent Schuyler bought a large acreage comprising the southern part of Kingsland's holdings. It was on this property that the mine was located and Schuyler's home was built.

Arent Schuyler was born in Albany, N. Y., in 1662, the sixth son of Philip Pieterse Van Schuyler, who had immigrated from Holland a few years previously and become one of the two founders of the family in this country.

Near the eastern side of the upland at a point known even today as Schuyler's Corner, Arent Schuyler erected his manor house, a notable homestead for those pioneer days, being constructed of stone and brick especially brought over from Holland. On the meadowland below was a dense cedar swamp, but between it and the hillside lay fertile soil which he cultivated as part of his plantation. Here it was, in 1714 or 1715, that a discovery was made. A negro slave, while ploughing, turned up a large stone whose unusual weight so excited his curiosity that he carried it to his master who investigated and found that it came from a bed of rock of the same character. Thereupon he sent the specimen to England for analysis and learned that it contained nearly eighty per cent of copper, that is, it was the primary copper ore which we know today as chalcocite.

The story goes to the effect that Schuyler, wishing to reward the slave who discovered the mine, gave him his freedom, and told him that in addition he might have three wishes granted. The negro's first wish was to live with his master as long as he lived, and to have a dressing gown "with big brass buttons just like massa's." His second was for all the tobacco he could use, but at this point his imagination failed him. He was urged to ask for something valuable, but after studying for some time and scratching his head, he concluded by saying, "I guess, massa, I'll hab a little more 'baccy."

Authorities differ on the exact year of the discovery, but one account states that hammers, wedges and other tools found in an old working of the vein opened by Schuyler indicated that it had been worked previously by the early Dutch settlers. In any event, the ore proved rich and highly profitable; it was packed in quarter barrels of which six weighed a ton, loaded on wagons and carted across the meadows to the Hudson.



Here it was loaded on ships and exported to Bristol, England, where it was sold for $175 per ton, and reduced to metal, for the colonists were not allowed to smelt ore and refine copper. An interesting family tradition handed down among the descendants of Arent Schuyler states the ores obtained by him contained enough silver to pay the cost of smelting, and that at least a part of the silver was always returned to this country in the shape of English coin. Some substantiation of this tale is given by the fact that the State Geologist reported in 1906 that "a small amount of silver is always present" and a specimen of ore examined at Rutgers College yielded 4.4 oz. of silver per ton and a visible gold bead.

One of the earliest accounts is that of Brig. Gen. Robert Hunter, governor of the Colonies of New York and New Jersey, who writing from New York, Nov. 12, 1715, to the Lords of Trade, emphasizes that the mine was of considerable importance even at that time, for he states: "There being a copper mine here brought to perfection, as you may find by the Custom House books at Bristol, where there was imported from this place about a Tonn in the month of July or August last, of which copper farthings may be coined."

When first worked, the yield averaged about 100 tons per annum, and another colonial record tells us too that in April, 1721, there were 110 casks of ore from this mine shipped from New York to Holland, and the Surveyor of the Port of New York wrote that "Copper Oare now rises very rich and in great plenty in a new-discovered mine of one Mr. Schuyler in New Jersey," and by 1731 the output to the Bristol Copper and Brass Works is said to have reached 1,386 tons. Thus the Schuyler family became wealthy from the production of the ore, from royalties and finally, from the sale of the property.

The shipment of ore to Holland greatly disturbed the Lords of Trade, who suggested that Parliament should prohibit it. At the request of the Duke of Newcastle, Governor Montgomerie conferred with Col. Schuyler (son of Arent Schuyler) about the matter, but secured from him only the promise of

letting the English Copper Company have the first sight of his ore when his ships arrived in England with it. This was in 1730. Strangely enough, however, four years later, the New Jersey Legislature itself imposed a duty of 40 shillings per ton on all copper not directly exported from the province to Great Britain; but still more strangely, the brass and copper factories of Bristol were the first to complain of the new law which was evaded by shipment of the ore to New York and thence to England and elsewhere, and the Bristol traders were apprehensive that mining operations would be discouraged.

The mine was worked for many years and continued to yield large quantities of rich ore, until it was worked as deep as hand and horsepower could clear it of water. The successful solution of the formidable difficulty thus presented, actually initiated the age of steam in America.

In the meantime, Arent Schuyler died, and by the terms of his will proven on July 6, 1732, the mine was left to his three sons, Col. John Schuyler, of the Regiment of Militia and of the Regiment of Horse in the County of Bergen, Colonial Wars, having the management for himself and his brothers.

Benjamin Franklin visited this celebrated mine in 1749, and he writes to Jared Eliot from Philadelphia on February 13, 1750: "I know of but one valuable copper mine in the country, which is that of Schuyler's in the Jersey's. This yields good copper and has turned out vast wealth to the owners. I was at it last fall, but they were not then at work. The water has grown too hard for them, and they waited for a fire-engine from England to drain their pits; I suppose they will have that at work next; it cost them one thousand pounds sterling."

Owing to the difficulties of communication, this engine destined to be the first steam engine in the United States, although ordered in 1748 or 1749, was not shipped from England until four years had passed.

Steam engines were then being used with great success in the coal mines of that part of England known as the "Black Country," and in the deep tin and copper mines of Cornwall.

Joseph Hornblower and his sons were engaged in the construction of these "fire engines," as they were then known, and to him Col. John Schuyler sent for the machine, asking that an experienced engineer should accompany it and place it in position. Josiah Hornblower, then only 24 years old, built this engine in England and left home May 8, 1753, on the sailing ship "Irene." The engine arrived at New York, September 9, 1753, and was landed at Second River (now Belleville, N. J.), whence it was carted to the Schuyler mine where Hornblower proceeded to set it up. In old account books of the Schuyler mine, such items as the following are found:

"1753

Sept. 25—To cash pd for 8 days, carting ye engine & board to ye mine at 6 s £2-8

Oct. 25—To carting 624 bushels lime to ye mine for ye engine house £2-0-0

Dec. 28—To cash pd for 16 days carting timber to ye sawmill & mines for ye engine house at 6 s £4-16-0

1754

Jan. 8—To 6 days slaying timber for ye engine £1-16-0

June 13—To cash paid Josiah Ward for 1 days carting fire stone for ye engine from the mountain 8-0

Oct. 28—To pd Thos Plummer & Thos Barnes for putting the boiler at ye engine house together £35-1-6

1755

Mar. 12—To 52 days carting stone & firewood for ye engine £15-15-0

The shaft to which the engine was taken had been sunk about 1735 and was 100 feet deep when operations were suspended. The engine house was built some 300 feet northwest of the shaft, and the machinery installed and started probably some time in March, 1755. It must have been a gala day when this, the first steam engine in the United States moved its ponderous mechanism, and its construction well merits a brief description.

The boiler, around nine feet in diameter and of about the same height, was placed directly below the cylinder and connected with it by a short pipe fitted with the valve which governed the admission of steam.

The cylinder was three feet in diameter and eight feet long, with a stroke of six or seven feet, the piston making ten or a dozen strokes a minute.

The safety valve was simply a heavy lid resting on an opening into the boiler; the valve movement was of primitive design—a narrow board connected to the walking beam and holding pins for adjusting the point of cut-off.

Small water tanks for condensing the steam were supported several feet above the cylinder, the condensed steam draining into a hotwell by the furnace. The space above the piston was quite open to the atmosphere (all engines of that date were of the Newcomen type), the pressure on it being just in excess of that required to lift the water from the required depth.

The pump cylinder was ten inches inside diameter with a rod six inches square, the original pipe being about six inches diameter. The pipe itself was of cast-iron and made in lengths of about eight feet, each with a pair of trunnions by which it could be kept vertical while being lowered into place, and weighed a ton and a quarter a piece.

Crude as this apparatus was in design and construction, the pump had a capacity of 134 gallons a minute or 180,000 gallons per day, and proved sufficient to keep the flow of water down for many years.

In time, however, even its clumsy strength proved inadequate to the task of keeping the mine dry, the shaft was abandoned, new ones essayed, but in the end all operations were suspended.

The Victoria shaft, named at about the time of Queen Victoria's coronation and reputed to be the first sunk in this country, is said to be 347 feet deep, but filled now with rock and debris, its site a crater-like depression in a vacant lot a quarter of a mile from the face of the hill. The old Cornish pump is still in position at the bottom, from which three drifts averaging 200 feet long are said to radiate, buried in mud and fallen timbers. Its great valve, however, and fragments of the pump rod and even the actual foundations of the historic engine, survived to see the 20th century and have been photographed.

In 1761, Hornblower became party to a lease on the mine extended subsequently to twenty-four years, and in turn sub-leased part of their interest to Philadelphia parties who worked the property until 1768. After two years' idleness, New York operators carried on work for four years when the engine house was burned by a discharged workman in 1753. That discouraged any further work for twenty years except surface digging, in spite of the fact that after a century of prospecting, this was really the first mine of any value that had been discovered. The books of this period show that ore then brought from $8 to $10 per 100 pounds.

Hornblower, it may be explained here, had built the road to Schuyler's home in 1765, which became the principal one between New York and inland New Jersey, and used for military purposes. It is said that the old cedar swamp whose stumps and trunks now lie buried beneath the meadows along the Belleville Turnpike west of the Hackensack was so dense that Hornblower was compelled to carry on most of the survey work with the help of lanterns.

During the Revolution, the mine lay idle, but in 1793 the New Jersey Copper Mine Association leased it from Col. Schuyler's son, Arent J. Schuyler, and shortly erected a dam, coal house, foundry and machine shop on Second River; and there Josiah Hornblower built for this company a stamp mill, the first in this country where the copper ore was taken to be stamped and concentrated. In the machine shop, also, the first steam engine built in this country was made, and in 1798 the first steamboat, Robert R. Livingsion's **"Polacca,"** of novel design.

Work was again abandoned early in the 19th century, and the engine broken up, the boiler being carried to Philadelphia where it was exhibited at the Centennial Exposition in 1876.

After 1833, the mine was operated for a few years by an English company, but the copper content of the ore proved disappointing to them, the mine was shut down, re-opened for a year in 1855 by a Philadelphia concern, and again abandoned.

From 1859 to 1865, the mine was operated vigorously with much of the old machinery by the Brisk company, 200 men being employed, but an ac-

cident to the pump led to the lower drifts being flooded so quickly that the miners were forced to leave their tools behind, the mine was closed, and after fire had destroyed the engine house, this company also passed out of existence.

In 1892, another company of too limited capital, attempted mining, but was successful only in causing a second cave-in, the first having occurred in 1866.

The final and most spectacular phase of the long career of this famous mine began in 1899 when the Arlington Copper Company, capitalized at $2,500,000, was formed to extract the copper by a patented German process, whereby the rock was to be crushed, pulverized, roasted, extracted with dilute acid, and the resultant solution electrolyzed to recover the copper, with a practical expectation of 36 pounds of copper per ton of ore.

The old tunnels, drifts and shafts were cleaned out and unwatered, a careful survey of the ore reserves made, and a large and expensive reduction plant designed to treat 125 tons a day erected on the side of the hill, some $250,000 being thus expended.

The rosy prospects of the stockholders were destined never to be realized, however. The results which had been attained in the laboratory, could not be duplicated in practice, the acid solution would not penetrate the roasted and pulverized ore, and, after vainly experimenting at length, the plant was sold at auction in the fall of 1903 and dismantled, never having produced a pound of copper.

Today the Schuyler mine lies buried far below the streets and sidewalks of a typical suburban development whose inhabitants for the most part are unaware of the ancient galleries and chambers beneath their homes. Turning north at Schuyler's Corner, the intersection at the top of the hill of the Belleville Turnpike with Schuyler Avenue,[1] a yellow brick chimney is sighted rising over the side of the hill down a grass grown street on the right. At the end of this street is a city fire-hydrant and, standing there, a great deal of interest may be observed.

Across the green meadows is seen the isolated height of Snake Hill, intermittent glimpses of the Passaic and the Hackensack, and beyond, Jersey City and the ragged skyline of all New York looming above the distant Palisades. To the right, streams the ceaseless traffic of the Belleville road which young Hornblower labored to hew through the dark cedar swamps of those remote days. To the right also, for hundreds of feet along the edge of the hill sprawls the vast dump piles of the mine, and a considerable variety of interesting and colorful copper minerals may be gathered here with a little searching—bright green malachite, blue green chrysocolla and dark green conichalcite (see **Addenda**). Confronting one are the melancholy ruins of the Arlington Copper Company which a third of a century ago became the last to attempt again to win the red metal from the red hill. On the edge of the meadow the old electrodeposition house is still used as a small factory. The fire-swept shell of the power house adjoins the rusty frame of the crushing house, its gaunt skeleton a geometrical pattern of decay. Alongside and up the slope lies the huge tube of the drying furnace culminating in the well preserved chimney—a sentinel monument to the high hopes of those who invested in the ill-starred venture. To the left of the power house, overgrown with trees and shrubbery, the foundations of the great lixiviation tanks are still in position suggestive of hidden ruins buried in a Yucatan jungle.

All this may be seen with little effort but without visible evidence of the mine itself, yet it is literally true that if the observer is not careful, he may almost fall into it, for the entrance lies just to the left about twenty feet below the street level. Scrambling down a slight declivity, a kind of deep pocket or indentation in the Triassic sandstone is noted, terminating in a small dark hole not likely to arouse any great enthusiasm in the uninitiated. Although at one time perhaps a dozen shafts opened into the mine, this narrow orifice is now the only means of access, for the original entrance has been progressively caved in, thus compelling the ex-

1 Shown on the small New Jersey metropolitan area maps of the New Jersey (Delaware) automobile road maps procurable at any service station.

plorer to slide feet first over the top of this accumulated rubble. Once inside, though, there is ample head-room for the tallest, so equipped with old clothes, rubbers, flashlights and candles, it is possible to wander underground several hours with assurance of seeing much of unusual interest to stimulate the imagination and to excite the curious.

The air is damp but fresh and cool, and is constantly renewed by a natural draft from west to east, and one of the minor mysteries of the mine is the source of this incoming air. Looking around, we find ourselves in a large, rock-hewn tunnel which slopes gently downwards (9 degrees) into Stygian darkness. This, for convenience, we shall term the Main Drift, and it proceeds into the hill 425 feet. A side wall opening invites entry and is found to lead through a series of small interconnecting chambers, in one of which a former entrance to the mine is now blocked up. Carefully constructed stone retaining and filling walls excite comment on their builders' skill, and squeezing through a narrow passageway, another group of little rooms is encountered. Emerging suddenly from one of these, we are surprised to find ourselves back in the Main Drift again, but deeper in the mine. We have merely traversed a circuitous by-pass, typical of the tortuous character of the veins which the miners excavated as they followed the ore. Our flashlights show many fascinating details peculiar to abandoned mines—hand-hewn mine timbers black and mouldy with age and moisture, rusty iron hooks driven deep into stony walls, huge drill holes bored by hands long since dust, mystic numerals and hieroglyphs painted on the rocks, and old shafts now filled with debris from above. The only life indigenous to this subterranean region are several species of weird white fungi. One of the most striking characteristics of the mine is a peculiar thin white film which coats the walls and ceilings of most of the older portions, giving them the appearance of having been whitewashed. In certain passages, this deposition[2] glistens with a shimmering, pearly iridescence Proceeding further, and ignoring "woodchuck holes" on the right, too small for comfort, we pass deeper underground, and shortly come to a

2 An unsuccessful attempt was made to determine the nature of this film, a sample removed with much care proving too impure to warrant detailed examination.

Stopes Along the Upper Drift

The Old Schuyler Copper Mine

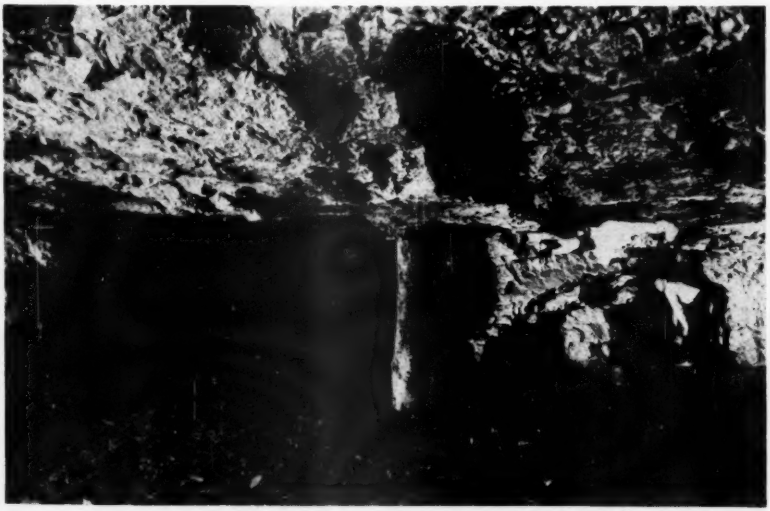
wide left fork featured by several large rooms or stopes from which much ore has been removed. This is the Upper Drift, some 180 feet in length, near the end of which is a cross passage. The ceiling here is very high and splashed with shining white patches, the effect when illuminated, being very decorative. On the right is a short tunnel and close inspection of it will reveal that it terminates in a filled-in shaft. To the left, the passage leads into a low ceilinged stope. The Upper Drift terminates in an upper gallery reached by climbing a plank, and then continues for a considerable distance as a small and winding tunnel.

Retracing our steps to the Main Drift, we are suddenly startled by a mysterious rhythmic sound suggestive of distant machinery, and one wonders if the spirit of the old Cornish pump still labors in the darkness; but closer approach discloses the cause as only the steady dripping of water from the roof on sheet iron torn from the dismantled frame of the old crushing house outside.

Overhead, the remains of a small cross tunnel can be traced which plunges sharply downward to the right and can be followed a long distance before further progress is stopped by fallen rock. There is no doubt that this once connected directly with the Victoria shaft.

To the left of this branches another tunnel, the Middle Drift, as clean and dry as any public thoroughfare and about 150 feet long. It is terminated by several short tunnels, a large filled-in shaft and an interconnecting gallery at a higher level and of considerable length. Close inspection of the filled-in shaft will show a narrow hole leading to unknown regions below, but it is not advisable to attempt its passage.

Again returning to the Main Drift, and going onward and downward, the ceiling now rises high and the floor becomes steep, soon bringing us into a large low-roofed room roughly triangular in shape and distinguished by a single small wooden support in the center which looks very inadequate. This was christened the "Bridal Chamber" for want of a better name, and



The "Bridal Chamber" at the End of the Main Drift

The Old Schuyler Copper Mine

several blind tunnnels radiate from its far end. To the left, a short passageway leads into a room which leaves us in frank amazement as its huge dimensions become apparent. Its size is best displayed by placing numerous lighted candles around its perimeter, and with "The Devil's Ball Room" thus aptly revealed, we find ourselves in a gigantic vaulted stope 80 feet wide, 300 feet long and from 12 to 30 feet high. The roof is in part supported by three rock pillars of heroic size, frequent alcoves and short tunnels leading from the circumference, and it is not difficult to credit local rumor which hints that the Ku Klux Klan once utilized this great underground hall as a meeting place. The black loam under foot in this lower region of the mine was transported here in recent years in an unsuccessful attempt to establish a mushroom farm.

At the far end of the hall, a low stone wall has been constructed across the floor adjoining the last of the pillars. Surmounting this, it is seen to be a retaining wall designed to check the slide of a great cave-in whose tumbled rocks slope upwards into darkness and makes it easy to realize the fact that we are here a hundred feet below the surface.

Near the entrance, in a kind of alcove is a crystal clear pool of icy water replenished by the mine seepage, and flowing away into a straight tunnel in part filled with water too deep for shoe tops. It has been found that this connects with one of the old drainage tunnels, finding exit far outside on the edge of the meadow as a spring whose waters are highly esteemed by neighborhood residents.[3]

Behind the supporting pillars, still another passage opens with a timbered portal revealing a filled-in shaft, and proceeding along this our path is again stopped by water, but this time planks offer a precarious path to large rooms beyond. Almost at once, a huge timber roof support looms up before us cut from a single tree fully four feet in diameter. Further on, another great fall is found and a crooked gallery leading far down into the rock

Enough has now been seen, however, for us to comprehend that at least 100,000 tons of ore have been removed in the many years of operation, but it has been conservatively estimated that well over 5,000,000 tons are still available averaging 2½% of copper. Even this vast reserve can not compete with the almost limitless deposits of Utah, Chile and the Belgian Congo. Its days of usefulness as a producer of copper are no doubt over, but it is interesting to know that it has had other uses as well. Its hidden ways are said to have offered shelter to spies of the Colonial Army during the Revolution; and fifty years ago it was the scene of a novel depicting the story of a witch who dwelt in its lonely and abandond workings. Treasure has been found, too. In opening one of the old shafts, the company which was operating in the period of the Civil War discovered an old horse pistol, a silver tea set, and a number of silver spoons, bearing upon them the names of the old families of this section. It was conjectured the find was part of some robber's plunder hidden for safe keeping and never removed.

As we wind our way upward again through the dead darkness peculiar to underground places, our lamps and candles cast flickering distorted shadows, and one fancies the old miners "little folk"—the kobolds and the gnomes—peering and grimacing at us from behind the rocks. At the last, as we emerge blinking like owls into the bright warm air, there is a feeling not only of relief, but of centuries left behind as though we had suddenly stepped into the present from a very long time ago indeed.

3 Copper is exceedingly toxic to the algae frequently responsible for a disagreeable odor and taste in potable waters, in fact, the "biological test" is the most sensitive known for this metal.

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ADDENDA

Notes on Collecting Minerals at the Schuyler Copper Mine

According to Manchester,[4] the following minerals have been reported from Arlington and North Arlington (copper mine and quarries):

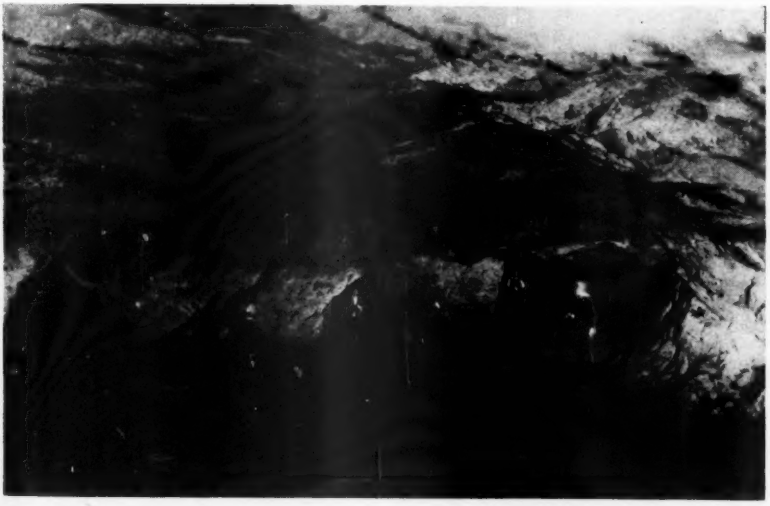
azurite
calcite
chalcocite
chrysocolla
coal
conichalcite
copper
covellite
cuprite
epidote
gold (in copper)
malachite
ocher (brown)
rutile
silver (in copper)
wad

To these, the writer wishes to add **selenite** and **brochantite,** neither of which has hitherto been reported from this locality.

Of the above, chalcocite, chrysocolla, conichalcite, malachite and ocher may be found without difficulty, and with a little luck and persistence, in specimens of very acceptable quality. Azurite, calcite, coal and covellite are much more rare, while selenite and brochantite are very rare. The others mentioned have not been found during repeated visits in recent years.

Many collectors have had poor success in collecting specimens at this historic locality, largely, no doubt, because they were unaware that for the most part the various species occur in very restricted areas which are not always easy to discover. As some guidance, therefore, to the uninitiated, it may be helpful to say that the best chalcocite and malachite are to be found on the talus just below the end of the (northern) sidewalk at the end of the street and just south of the entrance (i.e., just below the point on the sketch map marked "CE"; it is the "slight declivity" mentioned in the text). The chalcocite is black and very heavy, while the malachite is leaf green, heavy and not infrequently somewhat chalky. Chrysocolla and conichalcite are found on the slopes of the lower and larger dump pile at

4 James G. Manchester, "The Minerals of New York City and Its Environs," January, 1931. Bulletin of the New York Mineralogical Club, Vol. 3, No. 1, p. 64.



View in the "Devil's Ball Room" **The Old Schuyler Copper Mine**

the point "H". Both these minerals occur commonly as amorphous coatings in and on the broken rock, together with malachite. Chrysocolla may be distinguished by its blue-green color; conichalcite by its deep myrtle-green shade and glistening mammillary surface. Here, too, have been found selenite and brochantite lining small cavities with minute, colorless and emerald green crystals, respectively. Calcite, ocher and wad are found in dry fissure cavities in the shale rock walls south of the closed entrance "CE". Coal is found in thin isolated seams in the Middle Drift near the "cross passage." Azurite occurs sparingly as a bright blue coating on and **in** rock fragments scattered near the edge of the hill many hundred feet to the southwest, and directly east of the Public Service electric sub-station. Here, also, the southwest branch of an old disused mine road leads down into the old mine excavation. Adjacent to this road, on the right side just as the road dips to go down, is a low mound of debris, perhaps ten or twelve feet in diameter. Intensive inspection of this mound will reward the patient searcher with bits of covellite which may be identified by its weight and deep indigo blue color.

The most favorable time to collect specimens is directly after rain which not only exposes fresh material to view, but washes off the dust and greatly emphasizes the characteristic bright hues of the secondary copper minerals. Good light is very necessary, but the prime requisite for success is a conscientious and **close** inspection of limited areas which give indications of being productive, such as those designated.

It is difficult, for obvious reasons, to collect good specimens within the mine itself; but aside from this handicap, a tour of inspection may be arranged to suit one's convenience. Winter or summer, day or night—it's always the same (temperature) underground, albeit drier in the lower levels in the winter months. Warm clothing, old shoes, old hats, flashlights (with fresh batteries and extra bulbs), candles and hot drinks, are very much in order; and it is suggested that an underground picnic luncheon at the nd of the Middle Drift will be found to contribute an appropriate interlude to a novel mineralogical excursion.

Principal Modern References to the Literature Respecting the Schuyler Copper Mine at North Arlington, Bergen County, New Jersey.

1. Note regarding the presence of silver in the ore of the Schuyler copper mine.
   Charles A. Schaeffer, Native Silver in New Jersey Copper Ores. "Engineering and Mining Journal," 33, 90 (1882).
2. The occurrence of native silver in New Jersey on the Westlake property near the old Schuyler mine in Hudson County.
   Nelson Horatio Darton, "Am. J. Sc.," (iii) 30:80-81 (1885).
3. The Schuyler Copper Mines, New Jersey (three photographs and a map).**
   "Eng. and Min. Jour.," Vol. 69, Feb. 3, 1900, pp. 134-136.
4. Arlington Copper Company.
   "Eng. and Min. Jour.," March 23, 1901, p. 371.
5. The Extraction Plant of the Arlington Copper Company, by A. Von Zwaluwenberg.
   "Eng. and Min. Jour.," May 25, 1901, p. 661.
6. Arlington Copper Company.
   "Eng. and Min. Jour.," July 13, 1901, p. 49.
7. Arlington Copper Company.
   "Eng. and Min. Jour.," January 18, 1902, p. 119.
8. Arlington Copper Company.
   "Eng. and Min. Jour.," May 3, 1902, p. 638.
9. Arlington Copper Company.
   "Eng. and Min. Jour.," September 26, 1903, p. 483.
10. Annual Report of the State Geologist of the Geological Survey of New Jersey for the Year 1902, Trenton, N. J., 1903, p. 128.
11. History of the Schuyler Mine. The first copper mine operated in the United States.***
    J. H. Granbery.
    "Eng. and Min. Jour.," December 15, 1905, pp. 1116-1119 (three photographs).
12. The Copper Deposits of New Jersey.*
    N. S. Keith.
    "Mining Magazine," Vol. 13, 1906, pp. 468-475 (four photographs of Schuyler mine).

13. Regarding the presence of silver in the Schuyler copper mine ore. Annual Report of the State Geologist for the Year 1906, p. 143.
14. The Schuyler Copper Mine.**** "Journal of the Franklin Institute," Vol. 164, July, 1907, pp. 13-28 (with two maps).
"Journal of the Franklin Institute," Vol. 164, September, 1907, pp. 217-223 (with five photographs).
15. The Belleville Copper Mine. George Black.
"The American Mineralogist," Vol. 7, No. 9, p. 154, September, 1922.
16. A History of American Mining, 1932, pp. 6-7. T. A. Rickard.
17. The chemistry and metallurgy of copper, including a description of the principal copper mines of the United States and other countries. Philadelphia, 1858, p. 281. A. Snowden Piggott.
(This reference should have been No. 1, but it was received too late to be inserted in its proper place.)

Note: The asterisks indicate the relative importance of the leading articles.

PRAKTIKUM DER EDELSTEINKUNDE

(PRACTICAL KNOWLEDGE OF PRECIOUS STONES)

140 pages, 4 colored plates. Price in paper 6 RM; linen bound 8.60 RM

By GEORGE O. WILD

Reviewed by Carl H. Klein

From the press of the Franckh'sche Verlagshandlung, Stuttgart, Germany, comes a new and excellent book on gem stones, both precious and semi-precious.

The author, George O. Wild, director of the Institute for Precious Stones Research, a branch of the University of Frankfort at Idar-Oberstein, is exceptionally well qualified to write on this interesting subject.

The chapters on Crystallography, Light, Refraction, Reflection, Polarized Light, the Dichroscope, the Polarizing Microscope, Hardness, Specific Gravity, etc., are quite short and very readible. The adequate explanations and illustrations will appeal to the mineralogist and gem lover.

Thirty-four types of gem stones are described together with their several varieties. In the chapters on quartz gems alone, sixteen varieties are discussed.

Standard tables of hardness, refraction and specific gravities are included together with a particularly complete table of four pages covering color, chemical composition, usual source localities, notes on unusual characteristics, hardness, refraction, specific gravity, pleochroism, colors of light rays determined by the dichroscope and crystal system of all gems mentioned.

A chapter on synthetic gem stones is included.

Four beautifully lithographed color-plates showing fifty-eight gem stones in both crystal and cut forms help to make this book a most valuable addition to the "gemologist's" library. Numerous black and white cuts and illustrations further enhance the text.

Unfortunately the books is available only in the German language but it is to be hoped that the author will soon publish an English edition.

German-reading collectors and gem lovers will find this book a valuable and authoritative source of information on practically all gem material.

BOSTON MINERAL CLUB

The Boston Mineral Club was organized on Oct. 1st, 1936, and meetings are held on the evening of the first Tuesday of each month in the lecture hall of the Boston Museum of Natural History, 234 Berkeley Street, Boston, Mass. The club has a membership of 69 and its most memorable project to date is a collection of maps of New England, each marked with mineral localities worthy of inspection. Five meetings have been held so far, each being very enthusiastically attended.

The officers of the new club are: J. Alden Higgs, President; George A. Wilson, Vice-President; and Robert E. Hines, 70 Ardell Street, No. Quincy, Mass., Secretary-Treasurer.

Visitors are welcome to the meetings and collectors residing around Boston are invited to join the club. Further particulars may be obtained from the secretary.

THE SALT OF THE EARTH

The important role that minerals play in our daily lives is commonly overlooked because they so often do not reveal themselves directly in their natural state. What would it be like to spend even a single day without using salt, for example? In primitive times, salt was a luxury, and among African tribes today it is a sign of wealth. In our modern civilization, it has a multitude of uses. In the year 1935, nearly 8,000,000 tons of salt, valued at more than $21,000,000 was produced in the United States, its production constituting an important industry in Louisiana, Michigan, New York, Kansas, California, Ohio, Texas, Utah and West Virginia. Yet most of us do not think about salt at all, except perhaps that small percentage which is used for savoring food. Just suppose that a man were to arise one morning declaring that he would put the salt cellar out of sight and would not use anything made with salt for the remainder of the day, says F. E. Harris of the Nonmetal Economics Division of the United States Bureau of Mines, Department of the Interior.

His morning bath! No soap, of course, because salt is used in soap making; even the water, if he draws it from a public supply, has been treated with chlorine derived from salt. He expected to omit his customary glass of warm water and salt and also his salty mouth wash, but he cannot have even a drink of plain water. It begins to look serious.

As he starts to dress, the thought comes that almost all textiles, even his socks, have been treated with salt in the dyeing or other processes. Salt is used in tanning, so no shoes should be worn. Mournfully, he looks out of the window; but turns away again because salt was used in making the pane of glass. He can't go about in a barrel, so finally he crosses his fingers and puts on his customary clothing.

For breakfast, he would like some preserved peaches, only their bright-looking appearance, he knows, is due to salt. He eats an orange instead. "That's a good start. What next?" He contemplates, "Ham? Bacon? Chipped beef? Salted fish? At least I can have an egg—not a boiled egg because that requires water and I should want to break it into a glazed earthenware dish or glass—but I can fry it, myself." Going to the kitchen, however, he remembers that butter contains dairy salt and salt is used in processing vegetable oils and lard. Even if he had unsalted grease, he would have wanted to use the new glass frying pan. The simplest way is to eat the egg raw out of the shell. He can have no bread because salt went into the baking; and, while he did not think of it at the time, salt is also used in milling flour. Suddenly he has an idea, "Ah, milk is a perfect food! But no, it comes in glass bottles and even if I could get it fresh from the cow, the chances would be 10 to 1 the cow had just licked the brick of cattle salt that every wise dairyman provides. Even her hay might have been salted."

"I'll have to go primitive and eat nothing but the fruits of the earth and unwashed at that," he thinks. "No cheese, flour, canned goods, or pickles, nor any fish or meat that has been salted or preserved by any of the refrigeration processes that use salt. No ice cream frozen by rock salt on ice or kept frozen by salt ice or even solid carbon dioxide because in making that, too, some salt or derivative of salt might have been used. I can't even have indigestion because bicarbonate of soda is a product of salt, as are many other medicines."

Tired of his own thoughts, he goes into the library to read. No newspapers, he reminds himself, inasmuch as salt goes into the paper pulp making, and he must not touch the wallpaper for the same reason. A book is no better because not only has its paper been fabricated with salt but salt was utilized to prolong the life of the leather binding. Of course he cannot wear his glasses for reading. How about an automobile ride? Analyzing this situation, however, he recalls that

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Our new building is located and designed to attract the Tourist Collector. It is in Long Beach, California, only a short distance from the scenic West Coast (Roosevelt) Highway—Route 101 Alternate.

Attractions will include a mineral museum, mineral specimens for sale, and mineral supplies. MINERALS FOR SALE wil comprise specimens gathered by the management from world-wide sources and others offered for sale by about thirty mine-owners, miners and collectors in "key" localities. Some of these contributors have exclusive access to valuable deposits. Many, for personal reasons, do not advertise their specimens for sale. All of them will enjoy identical privileges with us, their specimens being sold for cash only at their own prices. Of all mineral men, certainly these people deserve remuneration for their specimens. They have devoted time and expense, often endured privations and even risked their lives, to get specimens. Yet their charges are very reasonable.

Information will be available for those who visit our store. A large file of places to go and people to see is being prepared for the mineral minded tourist. (See March '37 Rocks and Minerals.) Tourists planning to visit strange places and desiring to avoid bad roads, depleted deposits, forbidden access to deposits or other causes of "wild-goose chases", will do well to consult us when planning a trip. If you cannot visit us, send an itinerary of the contemplated trip. We will give an estimate of the cost of preparing the data. Costs will be limited to clerical hire, stationery used and postage.

Mineral supplies will include fluorescent lamps and books (both new and second hand). Many collectors desire to own a copy of Dana: Textbook of Mineralogy but cannot afford to do so. If you have a spare, used copy, let us sell it to one of them.

Price-lists of minerals for sale will be available after July 1st. Write for it. Owing to the cost of services that will be offered, it will be necessary to require return postage on all correspondence except price-lists (that will be mailed free.)

WE OPEN FOR BUSINESS ON JULY 1st. COME SEE US OR WRITE US

(When you write, register your wish to have collectors visit you. Unless you register, we will not bother you with callers even though we may have your name. Please follow the outline given in last month's ROCKS AND MINERALS.)

the glass, the lacquer on the outside, and sundry other parts of the car cannot be made chemically without salt. The lubricants, even the gasoline, may have been processed by one of the solvent methods that uses salt in some form. He is an enthusiastic amateur photographer but he is not sure which developers or fixing solutions are free from salt. He must not smoke because many brands of smoking tobacco are processed with salt. It is quite likely, too, that salt was used in the matches.

Perhaps he could manage to do a little gardening, but stroking his stubby beard that he was unable to shave that morning, which seems now so long ago, he thinks over the manifold uses of salt in agriculture. It is used in salting hay and in many of the insecticides and weed-killers. The fence posts may be treated with salt to keep away insects and fungi.

The day is too full of inhibitions, and as long as his vow is still operating the poor man cannot even go to bed. No refuge can be found between the salt-bleached and cleansed sheets, and he cannot even take childish refuge in salty tears. One thing, however, he has learned—that salt is one of many minerals that are vitally needed. It has fully 1,500 recognized uses. Here in the United States alone we require 8,000,000 tons of it a year, half of which comes from brine wells, and never takes even the form of dry salt. Sodium, one of the two chemical elements of which sodium chloride, or common salt, is composed, is a little known metal that catches fire when plunged in water but thousands and thousands of tons of it are used annually in the United States for making dyes and other organic chemicals. Easily melted, it is made to flow invisibly through steam-heated pipes, and in 40-ton tank cars it is carried clear across the continent.

Evaporated salt, produced either from the original brine of wells and ponds or from brine obtained by forcing water into beds of rock salt and withdrawing it for processing, represents approximately 30 per cent of the quantity of salt produced in the United States, the Bureau of Mines points out. Rock salt, mined underground, accounts for about 24 per cent of the production. Salt in brine cold or used by producers for the manufacture of chemicals makes up the remainder. In California, large quantities of salt are obtained by evaporation of ocean water, and in Utah salt is obtained by evaporation of the waters of Great Salt Lake.

UNUSUAL BOOKS

"The Book of Minerals," by Alfred C. Hawkins. The most complete book on Minerals ever published for $1.60 postpaid. Contains over 160 pages, in non-technical language the story of the important minerals, just how they are collected, formed, found, and identified. Special attention is given to gem materials. This book should be owned by every jeweler and gem lover.

"The Story of Gems," by Herebrt P. Whitlock, curator of minerals and gems, American Museum of Natural History. This book is just off the press. This book covers precious, semi-precious, and ornamental stones; it tells where they are found, how they are identified, and by what methods in what forms they are cut. It describes the ancient and modern uses of gems, their rarity, their color variations, the bases of their value, and many curious facts about them. The book is handsomely illustrated with a large color plate and many half tones from the Morgan collection, and contains a descriptive table, bibliography and an index. This book should be owned by every collector of gems and minerals and every jeweler. $3.50. Postage 15c.

"The Handbook for the Amateur Lapidary" by J. H. Howard. There has been only one complete book written on the art of gem cutting and this is it. Written in a simple nontechnical language. If you want to interest your boy or husband in a worthy hobby, purchase this book for him. $2.00 postpaid.

For sale by—Waldru Lapidary Shop, 2267 N. Dearborn St., Indianapolis, Indiana.

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FLUORESCENT AND PHOSPHORESCENT MINERALS FROM A LIMESTONE QUARRY AT HAILEYBURY, ONT., CANADA

By H. L. SHAW, Haileybury, Ont., Canada

The quarry situated about a quarter of a mile west of Haileybury, is being continually worked to supply limestone for use as a flux for smelting operations conducted by the Noranda Mine at Noranda, Quebec. The quarry has heretofor never been noted as a mineral collector's hunting ground; nor is it known as a locality for good fossils. The writer made several visits to it without finding anything of value and eventually gave it up as a hopeless and uninteresting spot.

After reading Zodac's "How to Collect Minerals," the writer decided to give the quarry one more visit and on June 28, 1936, in company with Mr. Julius Forster, we visited it again. The quarry is saturated with fossils of all sizes and shapes and investigations showed to our surprise that some of them had become crystallized by two minerals; some were solid, others contained cavities whose walls were lined with small crystals. A number of specimens were taken for further study and were later classified as barite and fluorite. The fluorite is transparent and white. The barite is opaque, in twinned wedge-shaped crystals, white, yellow and pink in color; the barite had crystallized over the crystallized fluorite.

That evening the writer decided to try his argon bulbs on the new find and was agreeably surprised to discover that the fluorite fluoresced a soft pale shade of green while the barite showed a medium orange color. They both phosphoresced; the fluorite the stronger.

To the writer's knowledge, this is the first occurrence of fluorescent and phosphorescent minerals known in the district. Many inquiries have failed to produce information contrary to this statement.

J. A. GRENZIG, 299 Adams St., Brooklyn, N.Y.

BOOKS IN STOCK

	Price	Postage
The Story of the Gems. By Herbert P. Whitlock (just issued)	$3.50	15c
Getting Acquainted With Minerals. By Geo. L. English	2.50	15c
Minerals of New York City. By James G. Manchester	2.50	15c
How to Study Minerals. By Edward Salisbury Dana	2.00	15c
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Dana's Text Book. By Wm. E. Ford	5.50	25c
Dana's System of Mineralogy	15.00	50c
The Fluorescence of Minerals. By Chester B. Slawson, with plate of 24 natural fluorescent colors by photo	.50	05c
The Amateur Lapidary. By Charles L. Shimmel	1.00	...
Gilbert's Rudiments of Minerals.	.25c	05c
How to Collect Minerals. By Peter Zodac	1.00	...
The Book of Minerals. By Dr. A. C. Hawkins	1.50	...
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Field Book of Common Rocks and Minerals. By Prof. Fred B. Loomis	3.50	15c
Gold Prospecting. (2nd Edition, By Stephen Jacy	1.60	15c

THE CANON CITY EMBAYMENT

By F. C. Kessler, Canon City, Colorado

The Canon City Embayment of the great inland sea that stretched at one time from the Gulf of Mexico to the Arctic Ocean is about forty miles long, extending from Pueblo, Colorado, west to the foot of Fremont's Peak, just west of the city of Canon City. The embayment is about twenty miles wide near Pueblo and tapers to about four miles at the western extremity. It is bounded on the north by the Front Range and on the west and south by the Greenhorn Mountains, and is drained from west to east by the Arkansas River.

Pre-Cambrian

The Front Range, Fremont's Peak and the Greenhorns are of Pre-Cambrian formation, whose country rock such as schists, gneisses and quartzites abound on the higher levels and contain various non-metallic minerals and some semi-precious stones.
Type locality:

Muscovite mica and feldspar are shipped from a quarry on the northwest side of Fremont's Peak. In that quarry is also found rose quartz which is somewhat gemmy.

Black tourmaline is found near the north brink of the Royal Gorge, but the diggings are not worked now.

A poor quality of beryl is common in the gneiss north of the summit of the peak.

Columbite is common near the top and is found in well formed crystals but not in paying quantities.

Vermiculite is sometimes mined in the Greenhorns along Grape Creek.

Gold has been found on the Greenhorns on Cow Creek, but the assay does not warrant investments necessary for mining.

A large pocket of garnet is located on Green Mountain in the Greenhorns. The garnet is of high abrasive quality.

On Current Creek, about two miles north of the Salida road, is a vein of well colored amethyst, but it is too faulty for large cuttings.

North of Marble Cave are small eroded garnets of about watch jewel size that may have gem value.

Rose quartz is found in abundance on top of the Greenhorns, on Fremont's Peak and at Zingheim's quarry near Park Dale.

Ordovician

The Ordovician series lies inconformably upon the Pre-Cambrian at the west end of the embayment along the base of Fremont's Peak, Priest Canon, and Twin Mountains. The outcrop occurs in an uneven fault-scarp that rises in some places to a height of two hundred feet or more.

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All three formations of the series are present and contain their characteristic fossils.

Type Locality:

The Manitou or lower Ordovician outcrops at Priest Canon, bearing echinoderms, gastropods, brachiopods and graptolites.

The Harding Sandstone occurs at the east end of the Royal Gorge and is rich in rare fossils such as phillopods, orthoceras, Ordovician fish scales, and gastropods.

The Fremont or upper Ordovician is eroded out at Twin Mountains and contains coral formations in various types of single, double and mass developments.

The limestone of the Fremont formation is highly dolomitic and in some places has been metamorphosed into a marble of high quality, estimated by government geologists to be equal to Siena marble for building purposes.

At the south end of Twin Mountains is an outcrop of travertine, some of which has been shipped to Denver for building purposes. Another outcrop occurs at Cotopaxi, Fremont County, from which the finishing veneer of the Telephone Building of Denver was obtained.

A vein or pocket of ochre is exposed in the north wall of the Frankenberry quarry. The ochre is of a dark red color and tests high in iron, containing no sand or grit.

North of the embayment the Ordovician dolomitic limestone forms the greater part of the country rock for about fifteen miles.

At Specimen Ridge near Oak Creek Grade the Ordovician limestone is hard and crystalline. At the contact with the Pre-Cambrian, chalcedony occurs in large quantity, highly colored, and of gem quality. Agate nodules, geodes, topaz crystals, and jasper predominate. Brachiopods are the only fossils found there so far.

Cretaceous

The Cretaceous series follows the Ordovician and rests unconformably upon it. The Morrison or Red Beds, as it was called by Haden, consists of a coarse red or pink sandstone that yields readily to erosion. It occurs in the form of a wide trough on the west and north side of the embay-

FULGURITES

FULGURITES are quartz tubes formed by lightning striking sand. These tubes sometimes run ten feet down in the sand but are generally broken into small pieces in extracting as they are very brittle. 1" long, 10c; 1½" long, 15c; 2" long 25c.

CAESIUM BERYL, Maine. A white beryl carrying a small amount of Cs.—1" 15c; 1½" 25c; 2" 50c; 3" 75c; 4" $1.50.

WOLFRAMITE. From the old Ozark mine at Silver Mine, Mo., now exhausted. Nice specimens.—1" 20c; 1½" 45c; 2" 75c; 3" $1.50.

HUBNERITE, Montana. Near Wolframite in composition but contains MnO. Brown, needle like xls in white quartz.—1" 20c; 1½" 30c; 2" 60c; 3" 95c.

LOLLINGTITE, So. Dakota. A silvery white, iron-arsenic mineral. 1" 15c; 1½" 25c; 2" 50c; 3" $1.00.

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110 EARL ROAD **MICHIGAN CITY, INDIANA**

ment. The trough will average about 3000 feet wide and continues northward through the state.

The eroded Morrison sand makes a beautiful road material for lawns and parks since it is of a deep pink color, but in some places it contains clay enough to hang on to your shoes and naturally soils the porch floors.

Type Locality:

West of Sand Creek near the prison farm is Palace Cave which really is a natural bridge about 75 feet long, 10 feet high and 30 feet wide. The abutments on either side are of coarse red sandstone while the span or floor is of a hard conglomerate.

A few hundred yards south of Palace Cave is a block mountain distinguished for its diagonal lines of cross-bedding, capped with a hard, conglomerate.

Red Canons, a municipal park, noted for its grotesque figures caused by differential erosion, is about 15 miles north of Canon City.

In Garden Park, dinosaur remains are excavated from time to time by various scientific groups. They seem to be most plentiful in the upper part of the Red Beds. The Canon City High School has fragments of two partially excavated, to which science classes are taken for study.

The Dakota formation in south central Colorado, according to Dr. R. D. George, consists of two layers of buff sandstone with several large layers of shale between. The lower formation of sandstone is called the Purgatoire which was laid down in brackish water. The shales consist of probably the Pierre, then the Niobrara and the Benton, that run in colors, light gray, white or cream, and black respectively. Above the shale is the upper Dakota sandstone known as Fox Hills. At the contact of the Morrison and Dakota is a deposit of gypsum that measures in some places as much as thirty feet in thickness.

The sea floor of the embayment through which the Arkansas River flows consists of about four feet of very fine sand which suggests wind deposit. Under the fine sand is about two feet of river drift composed of coarse gravel and small cobblestones, rounded and worn by water erosion. Several mesas of Fox Hills sandstone are left on the plain and several small buttes of Niobrara shale appear. Coal, fireclay and oil are shipped extensively from Canon City and Florence.

Type Localities:

The Purgatoire formation or lower Dakota sandstone occurs in a high "hogback" running north from Canon City for about four miles, then northeast along the foothills towards Denver. This is a hard buff sandstone that lends itself readily to building purposes. The "Skyline Drive" has been built over this "hogback" by prison labor.

The Niobrara outcrops along the base of the main "hogback" in a row of little "hogbacks." This formation produces the fireclay west and south of Canon City and is very fossiliferous, producing clam shells, cephalopods and baculites in almost every outcrop.

The Pierre produces the oil of Florence.

A ridge or bar of Benton shale runs northeast along the "hogback" about four miles north of Canon City.

The Wolf Park coal mine near Alkali Gap probably pierces the Fox Hills sandstone and reaches the coal in the upper shales.

From the Chandler coal mine have been dug three large dinosaur tracks, one of which was placed in the Denver museum.

At Alkali Gap, in the Laramie sandstone, a large variety of plant fossils are found. They seem to be of semi-tropical plants, the viburnum, eriocolon and magnolia. The high school has a small excavation here that offers an excellent trip for science classes while doing field work.

At Concrete is located the Portland cement plant about twenty miles east of Canon City which manufactures cement from the Niobrara limestone.

Since territorial days Fremont County in which Canon City is located has been the center of non-metallic mining interests in Colorado. "Booms" and "Rushes" do not take place in non-metallic fields, however, this locality has produced much of the state's wealth. Interest in geology and metallurgy run high in Canon City. It has become a center of scientific study for eastern universities, both Kansas and Michigan have had summer camps in the vicinity while annual tours of state schools and colleges are common.

THE NATURE OF FOSSILS

By EDWIN V. VAN AMRINGE, Pasadena Jr. College

The Second in the Series: "Makers of the Modern World" as Broadcast Over KHJ and KPPC.

Announcer — One of the bitterest controversies of the past three centuries concerned the length of time of Creation, the age of the earth, and the nature and meaning of fossils. On one hand were those insisting upon a complete Creation in just six days and an earth only sixty centuries old. On the other were a relatively few who insisted on believing only what their eyes beheld. They found it necessary to assign a very great age for the earth, and a slow and gradual development of its inhabitants.

A group of these pioneer scientists, studying the construction of a new citadel at Verona, met in a rock quarry in northern Italy in the year 1517. They will speak for themselves in a cast consisting of:

Leonardo da Vinci (65 years of age) —Court painter and engineer to Francis I during the occupation of Milan.

Girolamo Fracastoro (34 years of age)—Professor at the University of Padua.

Allessandro Degli Allessandri (56 years of age)—Neapolitan scientist.

Georgius Agricola (23 years of age) —German student at the University of Padua, later the greatest metallurgist of his time.

As the scene opens, a workman is showing a large slab of limestone to the professor, Fracastoro. The noise of the quarrying operations and the shouts of the workmen are heard in the distance.

Workman — Pardon, Professor, but will you be so good as to tell me the cause of these queer lumps upon this rock. My companions and I have found many of the same in the quarry, and long have been our arguments about them.

Fracastoro—And well might they be long, my good man. for our greatest thinkers are in much confusion over the same subject. I fear some of us may get ourselves into grevious trouble if we are too persistant. Luckily the great Leonardo gives us aid, or we may have lost our liberty, if not our heads, before now.

Workman—But sir, you have not told me the answer. Is it that I am right in saying that these are shell fish buried in the rocks? Old Pietro, our foreman, says a curse shall be upon me for even thinking such thoughts. He says the good Father told him they were spoiled and unfinished refuse from God's workshop. I told him that I didn't think God would be such a poor artisan as to spoil so many, and he became very angry at me. He said there could never have been an ocean here on the dry land, because the land and sea were separated on the third day of Creation, and animals were not made until the fifth.

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Fracastoro—And a very good argument, too. I must meet the good Pietro one of these days. But here comes one older and more learned than I, the great Leonardo himself, and a distinguished looking stranger with him. Give me the stone, that I may question them upon it, and get yourself back to your work before your Pietro has **more** reason to become enraged. I am afraid your arguments may get you into trouble. Forget it all.

Workman—Thank you kindly, sir. I think I understand you.

Francastoro—Be off! You are not paid to have brains, unfortunate. Be off!

Da Vinci—And what, may I ask, is the rising young Professor of Philosophy doing at Verona in a quarry, soiling his hands with rocks and his social standing in converse with menials? Alas, dear Fracastoro, do you not know that only such freaks as engineers may touch Mother Nature and not have their morals investigated by their spiritual betters? You are young—you will learn. But stop! I am forgetful. Let me make you acquainted with the noble Allessandri, who has come all the way from Naples to study the construction of our citadel of San Felice. Incidentally he is interested in that same rock you are holding so unobstrusively. Come! What do you think of it?

Fracastoro—It is an honor, sir, to know you and to have you inspect our work. I prefer to reverse the question of Master Leonardo and ask the noble gentlemen what **they** think of these queerly shaped forms.

Da Vinci—Ah, Fracastoro, you are a true philosopher—cautious. But let Allessandri repeat the remarks he made on our walk hither.

Allessandri—Gladly. I was telling the Master of the many similar stones I have observed in my travels in the mountains of Calabria. I am certain they represent animals which once lived in the sea.

Fracastoro—But how do they now appear far below the surface on dry land?

Allessandri—I believe they were buried here long ago during an inundation of this part of the world.

Fracastoro—But what would cause such a catastrophe?

Allessandri—Ah! there you have me. But what if the axis of rotation of the earth had changed—what then?

Fracastoro—Yes, that might do it. Great masses of water would follow the changing equator. That is fine—it is undoubtedly the explanation.

Da Vinci—Surely, and quite orthodox. The Flood of Noah.

Francastoro—No, that flood had me worried. It was caused by rain, and its waters would be pure and fresh. Yet these mussels resemble those I have many times seen on the shores near Venice, and are not at all like those in our lakes. Such a short flooding would have spread the animals over the surface, not buried deep in the rocks. I now will worry no longer about old Noah.

Da Vinci—Here, here, young man! I thought you were so cautious. Do not so lightly cast aside beliefs held by so many of our greatest students. Not that I am not also unorthodox. But—gently, gently! Now **I** have seen these same interesting rocks from many of the canals I have constructed in this region, but for many years have said little as to my beliefs about them. I agree that it is hard to believe that these exquisite forms are desceptive concretions of minerals contrived by the Devil to mislead the minds of men. Yet such is the firm conviction of my master, King Francis.

Francastoro—Most of our Neapolitans believe that these fossils grew from living seeds transported from the sea in vapors, or came from some hidden womb within the earth.

Da Vinci—Yes, and others tell us that they were formed in the hills by the influence of the stars; but I ask where are the stars now forming shells of distinct ages and species? And how can the stars explain the presence of the many pebbles rounded as if by the action of breakers upon a beach? Yet, if I insist that the fossils were once animals living in the sea, it is necessary that the earth be far older than the limits allowed by the great theologians.

Fracastoro—Hush! Let us not discuss this further. Here is an impetuous young German, a student of mine at Padau, and I fear he has overheard us. He and I have already engaged in bitter controversy on the subject.

Agricola—Well! Well! Gentlemen. I hope you have confounded my good professor. I see he is at his favorite

subject again. Pfaugh! I thought he had more sense, or I would not have bothered with the long trip from Saxony.

Da Vinci—Hold! young man. Do not speak so hastily on that of which you have no understanding.

Agricola—Well, grandpa, who are you to stop me? Do not try to fool me with the old proverb about age and wisdom going hand in hand. Do not forget that there is no fool like an old fool.

Allessandri—Silence!! Barbarian of a Teuton. Do you know him whom you insult?

Agricola—No, and care not.

Allessandri—It is the master, Leonardo da Vinci.

Agricola—Ah! da Vinci, is he. Well—a good painter; yes, a fair engineer—but what does he know about rocks? You Italians think a master of one trade master of all. I have heard of his ideas on these fossils. Of course there is in the earth a petrifying liquid which may turn to stone leaves and bones, but as to these forms he calls marine shells, why anyone can see they are merely solidified from water along with the rest of the limestone.

Da Vinci (angrily)—How can one so blind with ignorance see anything?

Agricola—I can see enough of your dirty beard to long to pull it vigorously.

Fracastoro—Enough, Agricola, or I shall order you expelled from our college. Leave us at once!

* * * *

Announcer—And so for three centuries longer—clear thinking lost in a confusion of theology and ignorance. Such events as the pronouncement of the worthy Archbishop Ussher that he had discovered from a study of the Hebrew scriptures that the Creation had taken place on the 26th of October in the year 4004 B.C. at 9 o'clock in the morning—a gem which slipped into the margins of the authorized version of the Bible and thus received the sanction of the Christian church. And when was the argument settled? Only a hundred years ago, when proven facts began to displace pet theories, when laboratories encroached upon philosophers' armchairs, and when individuals began to insist on freedom from the chains of church and state. A CENTURY OF PROGRESS—CAN WE KEEP IT UP?

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THE AMATEUR LAPIDARY

Conducted by ARTHUR KNAPP
1401 Arch St., Philadelphia, Pa.

Amateur and professional lapidaries are cordially invited to submit contributions and so make this department of interest to all.

NEW EDITOR FOR THE AMATEUR LAPIDARY

With this issue of **Rocks and Minerals,** J. H. Howard ceases his activities as editor of this Department and Arthur Knapp of Philadelphia takes his place.

It is to be regetted that Mr. Howard finds that the press of business prevents him from continuing in the office which he founded and which he has filled so ably. The amateur lapidary owes a great deal to Mr. Howard. His books and his various writing in these columns have inspired many an amateur to undertake the pleasant pastime of gem cutting and have guided him in his early efforts.

The new editor, Arthur Knapp, is not a stranger to the readers of these columns, as he has been a frequent contributor. Mr. Knapp is an inveterate hobbyist. He makes jewelry of his own design, in which to set his gems and between times paints in oils or indulges in photography.

The Editor.

LAPIDARY NOTES

No change in policy in this department is contemplated under the new editor. These pages are open to anyone having any information of general interest to the Amateur Lapidary. Contributions are earnestly solicited, in fact this department can't get along as a one man show.

Anyone who does lapidary work as a hobby should not be satisfied simply in the production of gems. There is a lot as yet unknown about both the theory and the practice of polishing. The amateur should try new methods and appliances, and exchange information and experiences with others. When the amateurs got into the study of the polishing of telescope mirrors, they taught the professionals a number of things and there is no reason why the amateur lapidary cannot do the same.

The writer has spent a lot of time experimenting and knows how fascinating it is. Two series of experiments have recently been performed which are of interest, although both gave negative results.

The first series was to answer the question as to whether the vehicle, in which the polishing medium is mixed, has any influence upon the polishing action and in connection with this, whether the colloidal condition of the mixture has any influence.

The following mixtures were tried on quartz, topaz and tourmaline, on a tin lap six inches in diameter, turning (usually) at 1750 r.p.m. The polishing mediums of tin oxide, titanium oxide, ruby powder and the various aluminas were mixed with sweet oil, cylinder oil, sulphuric acid, tannic acid, acetone, alcohol, salt, soda, blue vitrol, soap, gum arabic, chalk, milk of magnesia, ammonium citrate and aqua ammonia. The laps were run both wet and dry.

In most cases there was no polish obtained. In many cases the results obtained, on both the wet and the dry lap, were better if the finger was run over the lap before the gem was applied. This is worth bearing in mind when you are having difficulty.

Only the following are recommended for trial. Salt, in any polishing mixture, seems to improve the action. Acid free soap seems to improve the action in some cases. The presence of even a trace of acid in any mixture seems to be detrimental. Zircons may be polished with a mixture of ruby powder and tin oxide in acetone, keeping the lap very wet. The final touch may be made with tin oxide in water on a dry lap. Anything softer than a zircon will sometimes yield a good polish under the same treatment, including peridot.

The series of experiments leads the writer to the definite conclusion that the colloidal condition of the polishing mixture has no influence.

The second question is whether there would be any advantage in a metal lap softer than pure tin. Several laps of combinations of antimony, bismuth, lead, zinc and tin were made, all appreciably softer than tin. These were tried wet and dry, fast and slow and with a number of the more promising combinations of polishing mixtures previously mentioned as well as the standard mixtures of tin oxide and water. The gem material tried included amethyst, topaz, zircon, peridot, quartz and garnet. No advantage could be found in these laps. Many of them would polish but the action was very slow.

Incidentally and aside from these experiments, the writer has never been able to polish peridot until recently when a lap made of very hard Masonite flooring was used with ruby powder and water. This combination gave good but not perfect results.

Arthur Knapp.

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Stephen Varni, eminent gem expert, and Dr. J. R. Evers, prominent surgeon and mineral collector, are sojourning in Florida, — and both at Miami, of that. Mr. Varni insists a severe attack of flu forced him to leave New York for the sunny South. Florida is reputed to possess a very recuperative rejuvenating climate. Somewhere in the State is, of course, the Fountain of Youth, Ponce de Leon did not find. But visitors, after drinking a few glasses of Florida orange juice, do not think it is even worth while to look for it. Mr. Varni swears by the climate. Dr. Evers's professional report has not as yet reached our editorial sanctum.

Mr. Varni has called upon old jeweler friends, inspected the marvelous shell collection at the Miami University, and lectured on gems at the Miami Beach High School.

Dr. Evers is spending his time in intensive training, "preparing," he writes us, "for the many mineral trips we will make this year."

A PEEK AT OUR MAIL

Rock Crystal Number Pleases!

Gastonia, N. C.—The February issue of *Rocks & Minerals* just arrived and I want to congratulate you on such a complete list and explanation of one of the most common, yet one of the most interesting minerals we have in this country. Needless to say, I am always anxious for the publication to arrive as I always get a great deal of pleasure in reading it and a great deal of valuable information. —Jno. L. Beal.

A Rich Publication!

Quebec, Canada—Rocks and Minerals was anxiously expected after my subscription was sent in last month, but honestly I never hoped to receive such a rich publication for the price paid. Indeed I was very pleased to admire the beautiful setup of the magazine and after I had readily gone over every page completely, I must tell you that I am one of the many in favor of facts told and presented in "black and white" eliminating the guess-work of searching in corners for pennyworth shaded colors shadowed by a less value of more brilliant and larger spots flashing in appearance and worthless in facts. In French my conclusion would be more like this: "Votre publication est epatante et indispensable par sa beaute exquise et sa valeur incomparable." J. M. Couture.

On a High Plane!

Minneapolis, Minn.—I want to congratulate you on your February number of *Rocks and Minerals.* This number contains a great deal of valuable material. This number still further maintains your publication and its very high plane. I especially appreciate the article 'How to tell right and left handed quarts crystals." —J. F. Corbett, M. D.

Must Have R. & M.

Elmhurst, Ill—I am enclosing money order for another year's extension. I wouldn't think of being without your magazine.—Glenn H. Modson.

Seconds the Idea!

Petaluma, Calif.—In the "Chips from the Quarry" of the January issue, Mr. Edwards suggests that the address of an author and other facts be added. I second his idea.—Bill Nisson.

A Nifty Magazine!

Somerville, N. J. — Rocks and Minerals is getting to be a "nifty little magazine." Keep up the good work.—C. L. Clinton.

Should All Be Grateful?

Colebrook, Conn.—I want to thank you for *Rocks and Minerals* which I look forward to each month. We should all be grateful for all the endless hours you put into it for our pleasure.—Mrs. Mahl A. Newell.

100% on the Square!

Palo Cedro, Calif.—My little ads put me in contact with many readers of *Rocks and Minerals* offering exchanges. I have made many exchanges and some regular "pen pals" through your medium and all were 100 per cent. on the square. I would trust any one of them to take care of a million dollars for me (If I had it) and know I'd find every penny when I called for it.—Mark M. Foster.

R. & M. Has a New Dress!

Centre, Als.—Congratulations on the new dress of *Rocks and Minerals.* It is a fine looking introduction to a very interesting interior.—Gilbert Hart.

To His Liking!

Loomis, Calif.—The February number of *Rocks and Minerals* is much more to my liking than many of the previous numbers. —C. N. Parmenter.

Proud to Own Complete File!

Pasadena, Calif.—I have been intending for some time to extend my heartiest congratulations to you for your excellent work with *Rocks and Minerals.* Whatever may have been its ups and downs, the magazine is certainly excellent at present, and we all hope it may continue to remain the same. Your agate number is a worthy successor to the famous opal issue, and most of your recent articles are extremely interesting and useful. Your type and format especially show this remarkable improvement.

Congratulations again on R. & M. I am proud to possess a complete file. Good luck for the future.—E. V. Van Amringe.

Articles Are "Tops"!

West Haven, Conn.—I enjoy *Rocks and Minerals* immensely. The articles on collecting trips are "tops."—H. A. Smith.

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CHIPS FROM THE QUARRY

(Formerly the Bullettin Board)

In the February 1937 issue of **Rocks and Minerals,** R. Emmet Doherty, in a letter to the Editor, stated complaints had reached him that his article "Chester, Vt., Land of Pyrite Cubes," which appeared in the July 1936 issue, was very misleading. That collectors on reading the article made special trips to the locality and failed to find the pyrites mentioned. On investigation, Mr. Doherty informed us, he learned that within three weeks after the article appeared, a number of individuals had visited the locality with trucks and hauled the material away.

Some weeks ago a subscriber in Colorado sent in a nice article on some interesting smoky quartz crystals of his state. Hearing of individuals in his vicinity who made a specialty of stripping localities of minerals and fearing they would learn of the new occurrence if the article was printed and directions for reaching the locality were given, he rushed an airmail letter to the Editor with instructions to delete the location notice.

In a letter dated January 22, 1937, Dr. W. C. Mayes, of Santa Ana, Calif., presented another problem. He writes: "In the May 1935 issue of **Rocks and Minerals,** appeared an article by Wm. C. Chandler **Mule Springs, Cali., An Interesting Locality for Geodes, Jaspers and Agates.** About three weeks ago, my daughter was going out that way and I gave her the copy of the magazine containing the article with the request that she get me some specimens. She stopped at the gas station near there, seeking information, and showed the article to the man in charge. To her astonishment, she learned that within a week following the publication of the article over 400 cars had stopped at the locality. The locality was evidently cleaned out as she found nothing."

We realize of course that **Rocks and Minerals** has a tremendous pulling power, that an article or advertisement inserted in its pages reaches many thousands of people. We are saddened however by the thought that if this cleaning out of localities will continue, collectors will be reluctant to divulge the locations of new finds. Perhaps we should take a more optomistic viewpoint, of the latter case at least, and feel that interest in mineralogy is being stimulated to a high pitch, that collectors are increasing all over the country, and that more localities must be made available. We would appreciate letters from readers giving us their viewpoints on the matter.

Coming — The 5th Annual Outing

The 5th annual outing of the Rocks and Minerals Association will be held Sunday, May 23rd. Four members have so far offered their services as directors for group outings. They are as follows:

Cal.—Wilfred C. Eyles, San Francisco
Ill.—H. W. Mauntel, Mendota
Mass.—John E. Kitson, Easthampton
N. Y.—Peter Zodac, Peekskill

The New York and Massachusetts groups will combine this year and will center their activities at the Strickland pegmatite quarry, Portland, Ct.

We hope to print names of more directors in the May issue.

ATTENTION AUTHORS AND WRITERS

Those authors and writers who are preparing articles for **Rocks and Minerals** and who may be in need of specimens for study purposes may borrow them from The Gem Shop, Box A-7797, Helena, Mont. and Peter Zodac, Box 29, Peekskill, N. Y.

There are no strings attached to the borrowing except that the articles for the preparation of which the specimens are loaned must be prepared solely for **Rocks and Minerals** and the specimens returned in due time.